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Critical success factors in distance learning construction programs at Central Queensland University: Students' perspective

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Abstract:

Distance education has gone through rapid expansion over the years. Many Australian universities are pushing the use of distance education in delivering construction education programs. However, the critical success factors (CSFs) in distance learning construction programs (DLCPs) are not fully understood. More importantly, students' demographic features may affect the selection of distance education technologies. Situation-matching strategies should therefore be taken by universities or institutions with different student cohorts. A survey is adopted in Central Queensland University (CQU) to identify and rank

the critical success factors in a DLCP in Australia where there is a significant number of earner-learners and students with low socio-economic background. The findings suggest that the most important CSFs include access to computers and internet, reliability of web-based learning sites, high relevance and clarity of learning materials and assessment items, the availability of web-based learning sites that can be easily manipulated and the capability of the instructors to provide well-structured courses. The findings also suggest that students with low socio-economic background have more rigorous requirements on interface design, instructors' support and the integration of practical components into courses. The results provide good guidance of the design and delivery of DLCPs and will be useful for universities and institutions who are seeking to implement the distance mode in construction education.

Keywords: distance education; construction education; critical success factors; low socio-economic status

Introduction

Distance learning emerged in response to the need of providing access to those who would otherwise not be able to participate in traditional face-to-face courses (Beldarrain, 2006). It is characterised by students being physically separated from their teachers and classroom for all or substantial portion of the formal, organised training or education program (Berge, 2002).

Studies have been completed to quantify the extent that distance learning is replacing traditional means of course delivery methods (McMullin and Owen, 2002). Allan and Seaman (2009) found that online enrolments have continued to grow at rates far in excess of the total higher education student population, with the most recent data demonstrating no signs of slowing. In the United States, it is found that (Allan and Seaman, 2009, p.1):

- Over 4.6 million students were taking as least one online course during the fall 2008 term; a 17% increase over the number reported the previous year.

- The 17% growth rate for online enrolments far exceeds the 1.2% growth of the overall higher education student population, which may be due to traditional on-campus programs using online courses as part of the curriculum.
- More than one in four higher education students now take at least one course online.

Such rapid expansion can also be found in Australia. According to the Department of Innovation, Industry, Science, Research and Tertiary Education (2012), 243,117 students were enrolled in distance or blended learning at the end of 2011, a 6.5% increase over the number reported the previous year. The 6.5% growth rate far exceeds the 2.4% growth of the overall higher education student population and the 1.4% growth of the students who have enrolled in the internal mode of attendance (i.e. traditional face-to-face learning).

The quality of student experience in the context of expanding student numbers must not be overlooked, especially in distance learning where students can feel a greater sense of isolation and remoteness. There were a few studies which focus on the successful delivery of distance courses. Volery and Lord (2000) identified six factors which are important to online courses. These factors include navigation, interface, interaction, student attitude, instructor technical competence and classroom interaction. Brook and Oliver (2003) added that learning communities can be put to good use in the support of online learning. Wu et al. (2003) found that curriculum design, interface design, interactive delivery and learning communities are of critical importance to a DLCP in Australia. However, the importance of these factors to the students' learning experience has not been fully investigated and the analyses of the importance of these factors from the students' perspective are lacking. Wilcox et al. (2005) pointed out that integrating into the university is a complex process and finding a place between old and new social contexts creates tensions for students which are often difficult to resolve. It is therefore imperative to understand the CSFs in DLCPs from the students' perspective to ensure learning effectiveness.

In addition, there are currently no benchmarks available to assess distance education quality in Australia. The Tertiary Education Quality Standards Agency (TEQSA) of Australia is still developing the national teaching and learning standards at the moment. The Australian Institute of Building (AIB) Accreditation Standard does not treat the distance mode and the traditional face-to-face mode separately (AIB, 2012). This may lead to universities failing to implement the distance mode effectively in construction programs. Understanding the CSFs in DLCPs may help the accreditation bodies to develop benchmarks to assess learning quality in distance learning. This paper therefore aims to present and investigate the CSFs at CQU DLCPs from students' perspective, which will be useful for other universities that are implementing or seeking to implement the distance mode. For the purpose of this paper, 'program' refers to a suite of individual courses/subjects and 'course' refers to one unit/subject within a program.

DLCPs in Australia

According to Williams et al. (2010), the construction discipline exists with other disciplines (such as engineering, architecture, property and business management) in universities in Australia. The construction discipline lacks a unique identity which may, in part, be due to its close association with higher profile disciplines such as architecture and engineering (Williams et al. 2010). The statistics of the construction discipline, e.g. student numbers, are sometimes reported with other disciplines.

The construction industry of Australia has experienced a significant growth over the past years. The construction industry gross value added and gross domestic product rose from 86,469m to 101,868m Australian Dollars, a 17.8% increase from 2008 to 2011 (Australian Bureau of Statistics 2012). The rapid expansion of the construction industry caused a strong demand of construction employees. The number of persons employed in the construction industry increased from 892,100 to 984,100, a rise of 10.3% from 2006 to 2009. Although the

number was decreased to 950,000 in 2012 because of the global financial crisis, the construction industry is still the third largest employer after health care/social assistance and manufacturing.

In addition to the growth of the construction industry, there was a growing demand for graduates who are familiar with new models of construction practices and additional management disciplines, such as environmental management, information technology (IT) and building information modelling (BIM). In a survey conducted by Central Queensland University (CQU) at 2013, it is found that there was an education-job gap, i.e. the discrepancy between the knowledge provided in construction education programs and the knowledge required at the construction sites, in the aspects of marketing management and BIM implementation. Such discrepancy has also contributed to an increase in student numbers in construction education programs. According to the Department of Industry, Innovation Science, Research and Tertiary Education (2012), the student numbers (Architecture and Building related, Bachelor) have increased from 19,345 to 21,059, a 8.9% increase from 2009 to 2011. The numbers of students who have enrolled in construction related programs in University of Western Sydney (UWS), the largest provider in Australia, have increased from 504 to 880, a 74.6% increase from 2008 to 2012. The numbers of students who have enrolled in construction related programs in CQU, one of the largest distance education providers in Australia, have increased from 381 to 443, a 16.3% increase from 2008 to 2012.

Currently, there are 13 universities that educate construction students in Australia. As can be seen from Table 1, two universities are providing construction programs using the distance education model. It should be noted that although the remaining 11 universities do not provide the construction programs by the distance mode, many of them provide some other courses by the distance mode, e.g. Deakin University and UWS. The term “DLCPs” in this

paper refers to construction programs which are offered exclusively by the distance mode or construction programs of which a substantial portion (≥ 50%) of the courses are delivered by the distance mode in a blended learning environment.

The rapid growth of online distance education worldwide has prompted the need to revise delivery structures and re-think traditional pedagogical practices. Consequently, the critical success factors in successful DLCPs should be revised along with the growth.

Critical success factors in DLCPs

A literature review of key criteria in distance education was conducted. The review considered in particular the critical success factors in online education, which included:

- Technology. Technology has played a very important role in distance learning. Pre-recorded and videotaped lectures have been developed for graduate degree programs in the late 1990s (Langford et al. 1994). Live business video broadcasts were also introduced to provide a quick, effective, and credible delivery method, which is also known as one-way or asynchronous video broadcasts (Alan et al. 1999). However, by using pre-recorded, videotaped lectures and one-way video broadcasts, it is believed that one important aspect of learning and teaching, i.e. interaction, is missing. A two-way video or synchronous distance learning system, e.g. Blackboard Collaborate, is now commonly used in many distance learning programs in many universities. The two-way video distance learning system provides communication, either audio or video, in both directions between the students and the lecturers. Interaction is therefore enhanced by using such system. Beldarrain (2006) also validated the importance of emerging technologies to the successful delivery of distance courses. For example, user-friendly applications can be used to create engaging learning environments. Really Simple Syndication (RSS) feeds can also be used to allow the

information to be “pushed” to the receivers, instead of the receiver having to seek the information (Ola and Niclas, 2005).

- Curriculum design. Swan (2002) stated that there is an enormous amount of content available through the internet. Quality of the online contents, including equitable use and perceptible information, may also affect the learning experience of distance students (McClary, 2013). If not appropriately trained, students, especially first-year students, may feel lost by it. Distance students are exposed to stresses caused by the delivery medium, academic writing skills, effective research and referencing in academic study. It is therefore necessary to build an effective interaction system between the students and the content, which is usually referred to as interaction with content (Swan, 2002). Janicki and Liegle (2001) provided a list of 10 concepts that are believed to be effective to develop web-based instruction. These 10 concepts are: (1) instructors acting as facilitators; (2) use of a variety of presentation styles; (3) multiple exercises; (4) hands-on problems; (5) learner control of pacing; (6) frequent testing; (7) clear feedback; (8) consistent layout; (9) clear navigation; and (10) available help screens.
- Instructor’s support. Instructor’s support is of vital importance to the successful delivery of distance courses because of the great sense of isolation that distance students may feel. Students can have higher self-esteem and feel more control of the study if they know that others will provide aid in stressful situations (Cohen and Syme, 1985). Unlike traditional face-to-face learning where lecturers can use immediacy behaviours, verbally or non-verbally, to lessen the psychological distance with the student, distance education, if not appropriately managed, is less effective for lecturers to present immediacy behaviours and will be less effective to lessen the psychological distance. Many researchers therefore argue that there is a heightened

need for instructor activity and interaction in online environment (e.g. Swan, 2002; Wu et al., 2013).

- Students' characteristics. The sociocultural theory stated that social interactions and cultural organised activities can influence the cognitive development of the students (Cobb, 1994). The students' availability and willingness to participate will therefore affect their cognitive development. In addition, Colley et al. (1994) found that prior experience, having a computer at home and gender were also likely to affect the effectiveness of online delivery. The demographic background of the students may also affect the delivery. For example, low socio-economic status (LSES) students can be reluctant to seek support from academic staff because they are unsure of the validity of their questions (Benson et al., 2009). Socio-economic status defines people's access to material and social resources as well as their ability to participate in society (Australian Bureau of Statistics, 2006). In addition, they may not be equipped with the skill-set of non-LSES students in terms of their academic, research, computer, writing and language skills, which are all necessary for online learning (Kirk, 2008). More importantly, the levels of academic preparedness of students from LSES backgrounds can sometimes be different from those of non-LSES students (Murphy, 2009). Situation-matching strategies are therefore important especially for regional universities which have a relatively high number of LSES students. At CQU, 25.6% of all students enrolled in construction related programs are identified as being of LSES. Similarly, At UWS, the ratio of LSES students is 17.9%.

Construction education has some unique features that should also be considered. Mathematics is fundamental in construction programs. The mathematical basis in construction education consists of a rather stable set of subjects such as linear algebra, calculus and statistics with a clear hierarchical structure (Perrenet et al. 2000). The importance of integrating practical

components in construction education has also been emphasized by industry advisory councils and accrediting agencies (Senior, 1998). Based on a comprehensive review of relevant literature on distance education and construction education, an initial list of 31 CSFs was compiled for this study. These 31 CSFs are:

1. The creation of web-based learning sites.
2. Reliability and stability of the web-based learning sites.
3. Easy access of the web-based learning sites.
4. Uniform templates for all courses.
5. Synchronous communication is embedded.
6. Asynchronous communication is embedded.
7. Concise design in learning materials.
8. High relevance of learning materials.
9. A wide breadth of coverage in learning materials.
10. A high depth of coverage in learning materials.
11. Audio features are provided to demonstrate the concepts.
12. Video features are provided to demonstrate the concepts.
13. Orientation course discussing the use of technology and academic learning is provided.
14. Orientation course discussing the mathematics used in DLCPs is provided.
15. Assessment items have high clarity relating to the requirements.
16. Practical components are infused into the assessment items.
17. The grades are returned to the students within an appropriate timeframe.
18. Web-assisted group assessment is used to enhance teamwork.
19. Attention is paid to the students' experience to the wider social world of the university.
20. Instructors can be contacted via different methods during office hours.

21. Instructors can be contacted via different methods after office hours.
22. Instructors are enthusiastic about the course.
23. Instructors have good control of the technology.
24. Instructors have good interactive teaching skills and can promote interaction.
25. Instructors can provide a well-structured/presented course.
26. Instructors have provided useful guidance about the online learning.
27. Students have prior experience in distance learning.
28. Students have access to computers and internet.
29. Students have some basic computer and IT skills.
30. Students are actively enrolled and are willing to communicate with the content.
31. Students are actively enrolled and are willing to communicate with others.

Research methodology

The DLCP at CQU

As a leading distance education provider in Queensland, CQUniversity is one of the two universities in Australia that provide construction programs exclusively by the distance mode (the other one is the University of Southern Queensland). The University is the largest provider of DLCPs with 443 students at the moment. The maximum candidature for the programs is 7 years. CQU introduced the Bachelor of Building Design (CU65) in 1990 and the Bachelor of Construction Management (CQ29) in 1995. The university now offers three bachelor programs, including Bachelor of Building Surveying and Certification (CG15) besides the above two programs, in the construction discipline. The delivery method is a combination of both asynchronous and synchronous strategies. Web-based learning sites are created for students to download course profiles, explore assignment tasks and communicate with each other via forums. Weekly lectures are organized through Blackboard Collaborate which can create a virtual classroom to offer an interactive learning environment.

The three disciplines share a common first and second year of study allowing students to elect their discipline after the completion of the initial two-year study. Currently, the building design students represent the largest group (47%), followed by building surveying (28%) and construction management (25%). 95% of the student cohort is employed full-time. Additional time management challenges exist. Since the introduction of online lecturers and the flipped classroom model in 2010, various time slots have been used to ascertain the best possible time for distance students to interact synchronously. Online activities (non-compulsory) have been conducted from 7am until 11pm on weekdays while certain activities have been conducted on Saturdays.

To date the attendance (ungraded and non-compulsory) has been sporadic at best, with students reporting difficulties in attending online lectures due to personal circumstances including work or family related activities. Online synchronous activities offered during office hours or during the traditional lunch hour (12pm-2pm) have also attracted limited attendance, with work related obligations rather than family commitments providing barriers. Of interest, daytime (12pm-2pm) online training to existing industry practitioners has been a regular feature of the School since 2012 and the ratio of attendees to accredited members is similar to that of student participation. Similarly, online participation in continuous professional development webinars presented to industry practitioners on the last Wednesday of every month between 5pm-6pm has seen a marked increase in take-up indicating that this time slot is more accessible for industry practitioners and may be more suitable for distance students.

With students in the distance education cohort located all over Australia, North America, Europe and the Far-East, it became necessary to extend the offering to beyond the norm of the flipped classroom or posted (online or otherwise) resource material. With the transition of hardcopy printed resource material to fully online in Built Environment programs in late

2010, lecturers were confronted with two different cohorts of students. One cohort (previously enrolled students) were used to receiving only printed resource material, having little to no interaction with lecturers and students and were happy with the ultimate flexibility that the primitive distance education model offered. They enrolled in the distance education program based on convenience and their personal ability to manipulate the academic program in to a vehicle that could take them where they want and when they wanted. The second cohort (new students enrolling in the programs for the first time) did not know what to expect and was happy to receive whatever resource material was made available. This cohort later became instrumental in setting the standard for the delivery of online programs. An unintended consequence of the new student service level expectation was that some lecturers were left behind in their teaching methodology leading to unbalanced course offerings. Training provided failed to overcome resistance to change for lecturers with a number of staff performing poorly in satisfaction and consistency surveys.

Data collection

To identify and rank the importance of the CSFs in DLCPs, a survey was conducted to include the distance students that were enrolled in the DLCP at CQU. Focusing on the distance learning construction program at CQU, this research is a case study survey, in which a survey is administered to a case, either a small sample or an entire population of individuals (Chmiliar, 2010). An online questionnaire was designed and sent to students who were enrolled in Term 2 courses from Jun 2013 to Oct 2013 at CQU. The students had distance learning experiences before (i.e. non-first year students) and would be able to identify the factors that might affect their learning effectiveness. The population was 133. A total of 66 responses were received. The response rate was 49.6%. In the questionnaire, the comprehensive list of CSFs in DLCPs was provided for students to rate. A five-point Likert scale was adopted to assess the importance of the CSF. The five-point Likert scale was: 1=

extremely unimportant; 2= unimportant; 3= neither unimportant nor important; 4= important; and 5= extremely important. Some demographic features about the students, including hours worked per week, previous distance learning experiences, socio-economic status, were also collected in the questionnaire.

Data analysis

The average rating (AR) and standard deviation (SD) of each CSF were calculated on the basis of the ratings from the 66 students. The statistical significance between different CSFs was then identified. Nonparametric test (Wilcoxon signed-rank test) was used to identify the statistical significance between different CSFs. The null hypothesis was that there was no significant difference between the CSFs in the paired sample. If ρ value was less than 0.05, the null hypothesis can be rejected. In other words, the two CSFs compared in the paired sample were significantly different.

Mann-Whitney test was adopted to identify the statistical significance between LSES students and non-LSES students. The null hypothesis was that there was no significant difference between LSES students and non-LSES students on the ratings of the CSFs. If ρ value was less than 0.05, the null hypothesis can be rejected. In other words, the rating of LSES students on the specific CSF was significantly different with the rating of non-LSES students.

Results and discussions

The importance of CSFs

Some demographic features of the students and their satisfaction rates of the programs are presented in Table 2. The satisfaction of the programs was rated by a five-point Likert scale, which were: 1= extremely unsatisfied; 2= unsatisfied; 3= neither unsatisfied nor satisfied; 4= satisfied; and 5= extremely satisfied. As can be seen from Table 2, a significant number of students from the DLCP at CQU were earner-learners who had a full time job while

undertaking study. 44 students (67%) had to work more than 30 hours a week. Earner-learners have a high demand of flexibility due to work and family commitment and this is one of the most important reasons why they chose the DLCP at CQU because the program is offered exclusively by the distance mode. In addition, unlike typical university students who are 18 years old, 50% of the students were over the age of 31. Those students were "untraditional" because they were adult students with a vocational training and work experience background (Schuetze and Slowey, 2002).

Although the construction industry was a traditional male industry, many women nowadays start to choose a career in construction. 44% of the students who participated in the survey are female. This might be caused by a widened access to the construction higher education and mature equal opportunity guidelines which were specifically directed towards building equality in the construction industry, e.g. by the National Association of Women in Construction (NAWIC) Australia. Moon (2013) found that family commitments and inflexible working arrangements were amongst the biggest threats to women maintaining a career in the Australian construction industry. The flexibility offered by the DLCP at CQU might contribute to the large number of female students in the program.

Another important demographic feature of the participants is the high percentage of LSES students (32%). LSES students might not be equipped with the skill-set of traditional students in terms of their academic, research, computer, writing and language skills, which are all necessary skills for online learning (Kirk, 2008). Consequently, the first-year GPA of the students in the DLCP at CQU was abysmal. The first-year GPA of the students in CQ29 was 3.16 based on a 7-point scale (F=0; HD=7), while the first-year GPA of students in CU65 was 3.71 in 2009. The overall satisfaction of the course was 3.8.

The average rating (AR), smallest rating (SR), largest rating (LR), standard deviation (SD) and asymptotic significance (A.ρ) are shown in Table 3. As can be seen from Table 3, eight

ranking groups were identified using the Wilcoxon signed-rank test. The most important CSFs include: students have access to computers and internet (AR = 4.77), echoed with previous research (e.g Volery and Lord, 2000). As all course materials and assessment items were presented in the web-based learning sites, it is important that students have reliable access to computers and internet. It should be noted that due to the large number of earner-learners, students with work commitment, e.g. fly-in fly-out (FIFO) workers, may have to work in remote area with limited or no internet access. Course apps were therefore developed to support such students. Study guide and resource materials of each week were provided in the course app. However, without reliable internet access, students would not be able to attend online collaborate sessions and submit assignments through assignment portals. The provision of course apps therefore did not preclude the use of reliable internet in DLCPs.

As shown in Table 3, a few technology-related CSFs were rated as important ones with ARs larger than 4.5. The creation of the web-based learning sites played a central role for students to download course materials (AR = 4.53). The engagement data, recorded since the inception of course, showed that the level of engagement peaked near the due date of assessment items. As can be seen from Figure 1, the level of engagement had three peaks: 21 July – 28 July (assignment 1 was due on 23 July); 15 Sep – 22 Sep (assignment 2 was due on 17 Sep) and 29 Sep – 6 Oct (assignment 3 was due on 1 Oct). The number of views per week for this course was 1891 and the number of posts per week was 53. In the three weeks when assignments were due, the number of activities were 5490, 3361 and 3154 respectively. Unfortunately, the high level of engagement was not always supported by a reliable and stable web-based learning site. On 22 July 2013, a significant number of students were trying to submit assignments one hour before the due date. The assignment portal failed to process the submissions partially because of the large size of submissions. It is therefore not a

surprise that the students gave a high rating of the reliability and stability of the web-based learning sites (AR = 4.53).

Important CSFs in the ranking group 2 include the provision of high relevant learning materials to assessment items (AR = 4.58); the provision of clear assignment requirements (AR = 4.58) and that instructors can provide a well-structured/presented course (AR = 4.53). As participation was not a gradable item, it is not a surprise that the results highlighted the importance of assessment tasks to distance students. According to a survey results conducted by the university, students were more willing to participate if the lecturer was enthusiastic. The lecturer therefore played a very important role in developing learning communities. A few good strategies can be adopted. The most efficient one would be to encourage students to share experience in the online forum by posting or in the Collaborate session by presenting. For example, the discussion of floods in Australia in the online forum led to many posts of students talking about their own experiences. Given the widespread geographic location (which basically covers every state and territory in Australia), such cognitive development is not something the students can obtain from traditional face-to-face classroom. This explains importance of instructor's support in organising and delivering courses (AR = 4.53).

The students in the DLCP at CQU were regularly deployed in a team environment. Team work activities in face-to-face learning environments could easily be established with the use of in-class role plays or scenarios where students had to participate in different project oriented roles, replicating industry conditions. The effectiveness of teamwork in education has far reaching benefits in terms of graduate readiness. However, it seems that the students were not keen to be involved in teamwork activities unless the activities were gradable items. As can be seen from Table 3, teamwork was only rated with an importance of 3.23. It should however be noted that radical changes have happened in construction project management in recent years. With an increasing number of Australian organisations opting to shift labour

related operations offshore to reduce operational costs, an increased level of global teamwork activities could be expected. To fit into the mainstream area of project management whilst remaining cost effective, one implicit skill that graduates need to possess is the ability to function effectively in teams. Simulated global virtual team (SGVT) projects were therefore used in some courses to ensure that students could function effectively. Global virtual teams (GVTs) have been described as culturally diverse functioning teams in a geographically distributed environment while utilising electronic means and other technology in delivering project outcomes (Harvey et al., 2004). Despite being rated as a low importance CSF by distance students, the importance of virtual teamwork skills could not be overlooked.

Based on the ratings from distance students, some other least important CSFs included prior experience of distance learning (AR = 2.64), experience to the wider social world of the university (AR = 3.30) and instructors' support after office hour (AR = 3.59). According to Yorke and Longden (2008), students who had not had prior experience of higher education admitted more often to have lacked commitment to their programs and to have felt the need for a break from education. However, students were not too concerned about the delivery methods of construction courses. As long as courses were well structured and managed, students did not think that the delivery method could affect learning effectiveness significantly. Due to the family and work commitment and a variety of uncertainties in the students' daily life, a relatively high rating of instructors' support after office hour was expected. Surprisingly, distance students claimed that after office hour support was not important when compared to office hour support. CSF 20 (office hour support) and CSF 21 (after office hour support) was significantly different ($A.\rho = 0.000$).

According to Volery and Lord (2000), technologies play a significant role in distance education. Ease of access and navigation (CSF 3) and interface design (CSF 4 and CSF 7), which were found to be critical to distance education by Volery and Lord (2000), were also

highly rated by distance students in DLCPs. Similarly, students' interaction with content (CSF 30) and instructors' participation (CSF 24) were also found to have relatively important impact on the effectiveness of distance learning in DLCPs, according to Musa and Othman (2012). On the other hand, several factors which were not important in previous studies (e.g. Volery and Lord, 2000; Musa and Othman, 2012; Puri, 2012), were found to be important for students in DLCPs. These factors included video features (CSF 12), instructors' guidance (CSF 26) and structured components (CSF 25). This might be caused by the uniqueness of student cohort of the DLCP at CQU. With a significant number of earner-learners and students from low socio-economic background, instructors' support is therefore regarded as more important for the DLCP at CQU than the distance learning programs at other universities.

LSES students

Table 4 illustrates that some CSFs were heavily influenced by the students' socio-economic status. LSES students tended to require that uniform templates should be used for all courses. In accordance with Attewell and Battle (1999), LSES students obtained less of an education effect from having a home computer. LSES students might be reluctant to navigate and research relevant information in the web-based learning sites if non-uniform templates were used. The interface design of the web-based learning sites therefore played an important role to improve satisfaction and retention of students with low socio-economic background. Concise and clear course navigation would help LSES students to identify the three most important tasks during term, which were: course profile, course communication methods and assessment tasks. In addition, a scaffolding system, which was used to describe effective learning support, should be provided based on the theory of zone of proximal development (ZPD) developed by Vygotsky, who defied ZPD as "the distance between actual developmental level as determined by independent problem solving and the level of potential

development as determined through problem solving under adult guidance or in collaboration with more capable peers" (Vygotsky, 1978, p.86). LSES students might not be willing to execute the tasks and activities that lead to successful learning and a scaffolding system should be developed to assist structured learning (Wu et al, 2013).

In addition, students with LSE background tended to require that practical components be infused into assessment items, which might be partially caused by their lack of confidence in securing employment upon graduation. Practical components in construction education are important because of the large number of variables in the construction industry and combinations about how these variables are interrelated (Senior, 1998). Construction managers usually make decisions based on the experience and cases or situations they have previously encountered (Senior, 1998). It seems that LSES students tended to gain some real-world experience before graduation. This tendency is much stronger than non LSES students ($A.\rho = 0.010$).

Students are more willing to participate if the lecturer is enthusiastic. An enthusiastic lecturer is more important to LSES students than to non LSES students ($A.\rho = 0.030$). An enthusiastic lecturer can also be capable of developing effective learning communities by promoting interactions. Such communities are more important to LSES students than to non LSES students ($A.\rho = 0.010$). One strategy would be to encourage students to share in the online forum by posting or in the Collaborate session by presenting, although asynchronous communication was preferred than synchronous communication ($A.\rho = 0.009$).

Conclusions

Critical success factors are useful to develop and improve distance learning construction programs. Although there were some critical success factors identified for distance education in previous literature, these CSFs were not always useful in construction education because of the specific feature of the construction industry. For example, mathematical basis, including

linear algebra, calculus and statistics, is fundamental in construction education; Virtual teamwork skills are essential for graduates to succeed in the ever-changing global construction industry. More importantly, construction students' demographic features, including domestic commitments of mature students, the need to take term-time employment and socio-economic status could impact students' academic work in distance learning construction programs. The design and development of such programs should therefore reflect the needs of the current specific student cohort. No uniform list of CSFs can support the development of DLCPs.

For a student cohort with a significant number of earner-learners and students from low socio-economic background, it seems that the most important critical success factors include access to computers and internet, reliability of the web-based learning sites, high relevance and clarity of learning materials and assessment items, the availability of a web-based learning site that can be easily manipulated and the capability of the instructors to deliver well-structured course. Students with low socio-economic background have some additional requirements on interface design, instructors' support and the integration of practical components into course materials in order to secure employment upon graduation. Only when the requirements of distance students are fully understood can universities and institutions deliver successful distance learning construction programs.

It should be mentioned, however, that some potential implications should be further investigated. The data is collected from a sample of distance students in the DLCP at CQU. Using analytic generalization, which is not generalization to some defined population but to a theory that may have much wider applicability than the particular case, the applicability of this study outside CQU is not presently investigated and should be examined in details in future studies. The extrapolation of the study results to other institutions or programs should therefore consider this specific CQU context. Differences in student cohort should be

considered when applying similar research in other programs and other universities. In addition, a large sample size (>100) is needed if to investigate the hierarchical structure of the CSFs in DLCPs. Furthermore, a comparison between the CSFs in traditional face-to-face construction programs and DLCPs will benefit institutions and universities that are seeking to implement the distance mode in construction education.

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Figure Caption

Figure 1 The number of activities conducted by the students in the course

Table 1. The providers of DLCPs in Australia (Wu et al. 2013)

Institution	**On campus**	**Distance Learning**	**Name of degree**
The University of Newcastle	Yes	No	Bachelor of Construction Management (Building)
The University of New South Wales	Yes	No	Bachelor of Construction Management and Property
University of Technology, Sydney	Yes	No	Bachelor of Construction Project Management
University of Western Sydney (UWS)	Yes	No	Bachelor of Construction Management Bachelor of Housing
Bond University	Yes	No	Bachelor of Property and Sustainable Development
Central Queensland University (CQU)	No	Yes	Bachelor of Construction Management Bachelor of Building Design Bachelor of Building Surveying and Certification
Queensland University of Technology	Yes	No	Bachelor of Urban Development (Construction Management) Bachelor of Urban Development (Quantity Surveying)
University of Southern Queensland	Yes	Yes	Bachelor of Construction
University of South Australia	Yes	No	Bachelor of Construction Management and Economics
Deakin University	Yes	No	Bachelor of Construction Management
RMIT University	Yes	No	Bachelor of Applied Science (Construction Management)
The University of Melbourne	Yes	No	Bachelor of Planning and Design (Property Construction)
Curtin University	Yes	No	Bachelor of Applied Science (Construction Management and Economics)

Table 2. Descriptive statistics of respondents' characteristics

Profiles	Categories	No. of respondents
Age	18-20	14 (21%)
	21-30	19 (29%)
	31 and above	33 (50%)
Years of distance learning experience	Less than 6 months	26 (39%)
	6 months – 1 year	16 (25%)
	More than 1 year	24 (36%)
Hours worked (per week)	0	7 (10%)
	0-15	5 (7%)
	15-30	10 (16%)
	More than 30	44 (67%)
Sex	Male	37 (56%)
	Female	29 (44%)
Socio-economic status	Low	21 (32%)
	Others	45 (68%)
Overall satisfaction	3.8	

Table 3 Ratings, means and deviation of CSFs in DLCPs

Ranking	CSF No.	Description	Category	AR	LR	SR	SD	A.ρ
1	28	Students have access to computers and internet	Student's Characteristics	4.77	1	5	0.71	N/A
2	2	Reliability and stability of the web-based learning sites	Technology	4.59	3	5	0.61	0.041
								N/A
2	8	High relevance of learning materials	Curriculum Design	4.58	3	5	0.56	0.841
2	15	Assessment items have high clarity relating to the requirements	Curriculum Design	4.58	2	5	0.68	0.849
2	1	The creation of web-based learning sites	Technology	4.53	2	5	0.75	0.482
2	3	Easy access of the web-based learning sites	Technology	4.53	3	5	0.61	0.433
2	25	Instructors can provide a well structured/presented course	Instructor's Support	4.53	3	5	0.59	0.529
2	29	Students have some basic computer and IT skills	Student Characteristics	4.39	3	5	0.56	0.051
3	22	Instructors are enthusiastic about the course	Instructor's Support	4.38	3	5	0.62	0.047
								N/A
3	7	Concise design in learning materials	Curriculum Design	4.35	3	5	0.58	0.786
3	26	Instructors have provided useful guidance about the online learning	Instructor's Support	4.35	2	5	0.82	0.684
3	6	Asynchronous communication is embedded	Technology	4.32	2	5	0.80	0.543
3	4	Uniform templates for all courses	Curriculum Design	4.30	2	5	0.79	0.464
3	17	Grades are returned to the students within an appropriate timeframe	Curriculum Design	4.24	1	5	0.92	0.658
3	30	Students are actively enrolled and are willing to communicate with the content	Students' Characteristics	4.24	3	5	0.58	0.193
3	12	Video features are provided to demonstrate the concepts	Curriculum Design	4.23	2	5	0.72	0.208
4	10	A high depth of coverage in learning materials	Curriculum Design	4.14	2	5	0.73	0.020
								N/A

4	9	A wide breadth of coverage in learning materials	Curriculum Design	4.08	1	5	1.11	0.346
4	20	Instructors can be contacted via different methods during office hours	Instructor's Support	4.08	1	5	0.94	0.834
4	23	Instructors have good control of the technology	Instructor's Support	4.08	2	5	0.86	0.832
4	5	Synchronous communication is embedded	Technology	4.05	1	5	1.14	0.457
4	24	Instructors have good interactive teaching skills and can promote interaction	Instructor's Support	4.03	2	5	0.70	0.379
4	11	Audio features are provided to demonstrate the concepts	Curriculum Design	3.97	1	5	0.95	0.130
4	13	Orientation course discussing the use of technology and academic learning is provided	Curriculum Design	3.95	1	5	0.80	0.082
5	16	Practical components are infused into the assessment items	Curriculum Design	3.91	2	5	0.68	0.034 N/A
5	14	Orientation course discussing the mathematics used in DLCPs is provided	Curriculum Design	3.88	2	5	0.67	0.726
5	31	Students are actively enrolled and are willing to communicate with others	Student's Characteristics	3.80	1	5	0.94	0.281
6	21	Instructors can be contacted via different methods after office hours	Instructor's Support	3.59	3	5	0.46	0.044 N/A
6	19	Attention is paid to the students' experience to the wider social world of the university	Student's Characteristics	3.30	2	5	0.65	0.060
7	18	Web-assisted group assessment is used to enhance teamwork	Curriculum Design	3.23	2	5	0.68	0.015 N/A
8	27	Students have prior experience in distance learning	Student's Characteristics	2.64	1	5	0.86	0.000

Table 4 Ratings of CSFs by LSES students

CSF No.	Description	A.ρ	AR	AR by others
4	Uniform templates for all courses	0.015	4.62	4.15
16	Practical components are infused into the assessment items	0.010	4.24	3.76
19	Attention is paid to the students' experience to the wider social world of the university	0.034	3.57	3.18
22	Instructors are enthusiastic about the course	0.030	4.62	4.27
24	Instructors have good interactive teaching skills and can promote interaction	0.010	4.38	3.87
27	Students have prior experience in distance learning	0.012	3.05	2.44